

Historical aspects of amputation

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In 1955 it was possible to walk on to a surgical ward and from the door to recognise the patients who had an amputation. The ward sisters of the older school would have made the patient's bed with the lower blankets folded back to reveal the amputation stump while the normal leg would be covered by a separate blanket. Over the end of the bed hung a Samway's rubber tourniquet; both measures are designed to allow the warning blood staining the patient's dressing to be visible and the tourniquet provided to treat the torrential secondary haemorrhage that followed. These measures indicate the fear that remained of the lethal complications of amputation—shock and haemorrhage in the first instance, sepsis in the second—responsible for an appalling mortality from this procedure over the ages. Nevertheless, evidence of amputation has been obtained in both neolithic Neanderthal man and on Peruvian votive figurines, although most of these amputations were minor in extent and may have been traumatic or performed for ritual or punitive reasons. The first leg prosthesis was a bronze lower leg found at Pompeii, dated at 300 BC. This relic was unfortunately destroyed by an air raid on the Royal College of Surgeons of England museum in 1940. In earlier writings, Hippocrates (460–377 BC) indicated the need to ablate gangrenous tissue through the gangrenous part. Celsus (25 BC to AD 50) advocated a circular amputation technique and mentioned the possibility of ligatures to control bleeding. At AD 100, Archigenes and Heliodorus mentioned in their writing the use of amputation for disease, but for a long period in the dark ages there is little information available either from writings or illustrations. Henri de Mondeville and Gui de Chauliac advocating circular amputation, the use of cautery and on occasions the value of waiting for separation of the gangrenous tissue, even though in the case of a lower limb, this process might take months.

The miracle of Saints Cosmas and Damian, in which a below-knee amputation and cadaveric homotransplant being undertaken was portrayed, is dated 1500. There are many illustrations of this miraculous process. In 1517, Von Gersdoff of Strasbourg is attributed with the invention of the tourniquet, predating Harvey's description of the circulation by more than 100 years. Ambroise

Paré in 1585 made great advances in amputation surgery. He advocated bland dressings rather than red hot cautery or boiling oils. He used ligatures and was able to do this as he had a crow's beak iron haemostat that enabled the ligatures to be applied to a cut vessel. He also advocated the use of ligatures passed on the needle for transfixion. His feats as a surgeon on the battlefield are recorded and held in esteem to this day. He worked with a locksmith in Paris—La Petit Lorraine—who designed several of the earliest artificial limbs using the technique of the armourer and blacksmith to restore some function. In 1599, William Clowes described the above-knee amputation, and in 1593 William Fabry recommended the use of a tourniquet and that amputation should be above the diseased part. In 1639, John Woodall recommended that at least five helpers should be engaged for an amputation procedure and advocated an adequate period for preoperative prayers. In 1669, Pierre Verduin described in detail a below-knee amputation and designed a prosthesis of a type subsequently known as a metal eight, a thigh corset with side irons and a wooden foot. In 1679, C Lowdham of Exeter used the method of flap amputation cutting from within outwards and communicated his technique to James Yonge RN who contributed his own ideas on the use of terebinth oil as a postoperative dressing. Illustrations by Heister, in his surgical text of 1739, illustrate a long posterior flap below-knee amputation and also a crow's beak type of haemostat as introduced by Paré and its use in end ligations (Fig. 1). Samuel Wood is featured in a woodcut illustration in 1737 having survived a traumatic forequarter amputation, treated only with dressings. John Hunter (1729–1793), was rather conservative in his approach to amputation surgery and advised amputation through the necrotic rather than living tissue and, on the battlefield, preferred to wait until the patient had survived the initial shock and sepsis before attempting any elective late amputation. At this period, ligature haemostasis was achieved with cotton or linen thread ligatures tied with long ends to protrude through the wound and being pulled away when sloughing occurred, hopefully without a secondary haemorrhage.

The wars of the early nineteenth century brought a considerable emphasis on military amputations. In 1797 Admiral Lord Nelson received a gunshot wound at an attempted landing at Santa Cruz, Tenerife, where his



Figure 1. A late eighteenth-century amputation in St Thomas' Hospital operating theatre. Close inspection shows the back-hand technique of a curved amputation knife, an effective tourniquet and, on the table, an iron crow's beak type of haemostat.

ship's boat was raked by musket fire and, among the injured, the Admiral received a musket ball which severely injured his right arm. Fortunately his nephew, Lt Josiah Nesbit was present in the boat, applied a tourniquet, laid him on the bilge boards and screened his eyes from the sight of the blood. The boat, which had gone aground on the receding tide, was refloated and rowed back to the anchored fleet offshore. Nelson refused to be taken aboard his own ship and went to the *Sea Horse* where the surgeon must have been very surprised at the arrival of the injured Admiral who insisted on climbing on board himself. Thomas Eshelby, without any expert assistance, performed an above-elbow amputation rather higher than he intended and incorporating a nerve trunk in the brachial artery ligature. After this had sloughed, the stump was entirely satisfactory. At the Battle of Waterloo in 1815, the Earl of Anglesey, standing beside Lord Wellington, was struck by a cannon ball on the leg, and 2 h later had an above-knee amputation from which he recovered and was fitted with an elegant wooden prosthesis of a design that was perpetuated for more than a century. At the same battle (in which many thousands died and were injured), Lord Raglan survived an above-elbow amputation of the right arm. The English military practice was recorded by James Guthrie (1), the emphasis on early amputation, digital control of arteries where a tourniquet was not applicable. Guthrie himself achieved a successful hip disarticulation, but was concerned by the overcrowding in hospitals and the late mortality of military casualties. Jean Ulric Bilguer in the Prussian army advocated delayed amputation with initial incision and débridement, a technique in which he was in agreement with Sir Charles Bell in England. However, Baron Larrey made a great contribution with his concept of 'flying' horse ambulances to snatch casualties from the battlefield for early treatment. He also recognised the need to provide food and water for the injured left on the battlefield, and recommended that the dead horses should be butchered and cooked on the field to keep the injured alive until

evacuation could be arranged. He had a mixed attitude to amputation, selecting patients for early or delayed amputation. He also used ice where possible to obtain analgesia.

In the late eighteenth century, considerable advances were being made in amputation surgery. Chopart, in 1792, advocated disarticulation where possible, including his famous operation at the ankle. Lisfranc (1815) described the transmetatarsal amputation. Alanson of Liverpool advocated cleanliness in the procedure and a hollow cone technique.

In 1844 Malgaigne recorded the high mortality of amputation procedures, but the dream of all surgeons of the day was shortly to be achieved when, in the same year, Horace Wells used nitrous oxide for dental anaesthesia and, shortly afterwards, William Morton used ether and Sir James Young Simpson chloroform. However, despite the availability of anaesthesia, which was reluctantly accepted for military practice, the greater contribution was, perhaps, made by the reorganisation of surgical services in the Crimean War (1854–1856), when the late mortality of surgical amputation patients was improved by cleanliness and organisation in the hospitals. At this time, James Syme (1845) described his ankle disarticulation, Velpeau (1830) the knee disarticulation, Robert Liston established his fast technique for amputation surgery rivalled by Sir William Fergusson and Sir Astley Cooper. Pirogoff (1854), in Russia, described his ankle amputation, and Rocco Gritti (2) his supracondylar amputation, later applied by William Stokes (3). However, it was the use of antisepsis in surgery introduced by Lord Lister in 1867 that made the most fundamental contribution in minimising the dread complications of gangrene and sepsis with secondary haemorrhage. At this time, the Pean locking scissor type of haemostat was introduced, while Esmarch introduced his atraumatic tourniquet and surgery entered a new era. However, gas gangrene and sepsis remained the major complications of amputation surgery in the field, and during the First World War (1914–1918) the high incidence of anaerobic gangrene led to huge numbers of compound limb fractures being treated by primary amputation. A return to the concept of débridement rather than amputation was introduced at the time of the Spanish Civil War by Winnett Orr and Trueta, and the application of this practice through the Second World War greatly reduced the number of military amputees. However, the availability of penicillin in 1942 brought a new dimension to the control of Clostridial infections and allowed the development of more complex amputation procedures. Osteomyoplasty was introduced in Germany to obtain better muscle function in the below-knee amputation stump, while the concept of myoplasty to retain muscle function was advocated by Ertle. The possibility of a closed plaster technique to the amputation stump and the early use of a prosthesis was pioneered by Marion Weiss and Berlement (4) in the 1960s. The field of amputation surgery was changed when the incidence of amputation for trauma became very much reduced, but the remorseless progression of peripheral vascular

disease exposed an ageing population to the necessity of amputation. The value of early walking with a temporary pylon or walking aid was advocated by Devas and subsequently widely adopted. The immediate operative fitting of a plaster socket was popularised by Burgess and Romano and more sophisticated walking aids have been widely adopted. The ultimate progress in amputation surgery must be the achievement of limb re-implantation in trauma while the re-emergence of punitive amputations in some states must be viewed with disapproval.

References

- 1 Guthrie GJA. *On Gunshot Wounds of the Extremities Requiring Amputation*. London: Burgess & Hill, 1815.
- 2 Gritti R. Dell'amputazione del femore al terzo inferiore e della disarticolazione del ginocchio. *Ann Univ di med Milano* 1857;161:5–32.
- 3 Stokes W. On supracondylar amputation of the thigh. *Med-chir Trans London* 1870;53:175–86.
- 4 Berlemont M. Notre experience de l'appareillage prococe des amputés de membre inferieur aux établissements. Helio Marins de Berck. *Ann Med Phys* 4, 4.

Further reading

- Bouchet A. De L'amputation des membres et des instrumens qui son nécessaires. *Rev Lyon Med* 1966;15:927–36.
- Dederich R. The technique of myoplastic amputations. *Ann R Coll Surg Engl* 1967;40:222–7.
- Gordon-Taylor G. On Amputation. *Trans Med Soc Lond* 1942;LXIII:143–67.
- Oldham JB. Two eighteenth century Liverpool surgeons—Park and Alanson. *Proc R Soc Med* 1954;47:1056–8.
- Power Sir D'A. Some bygone operations in Surgery. VI. Amputation. The operation on Nelson in 1797. *Br J Surg* 1931;19:171–5, 351–5.

Book reviews

Laparoscopic Biliary Surgery by Alfred Cuschieri and George Berci. 101 pages, illustrated. Blackwell Scientific Publications, Oxford. 1990. £39.50. ISBN 0 632 02934 X

The first laparoscopic cholecystectomy in the human was performed in France in 1987. Within twelve months the procedure had been undertaken by a number of other French surgeons as well as by surgeons in the United States and Scotland. The authors of this admirably concise monograph were members of this select band and are now acknowledged experts in the field. In the past twelve months laparoscopic cholecystectomy has been performed in many thousands of patients throughout the world and seems likely to displace the open operation as the treatment of choice for symptomatic gallstones.

The early chapters cover training and education in laparoscopic surgery, documentation and instrumentation together with basic operative techniques. Then follows a detailed illustrated account of the technique of laparoscopic cholecystectomy followed by a useful chapter on laparoscopic cholangiography. The final chapter is devoted to laparoscopic cholecystostomy; the reference and further reading list is admirably up-to-date with numerous 1990 references. Due to the rapid advances in the field of minimally invasive surgery, it is likely that some aspects of this book will become obsolescent within a year or two, but for the moment the volume gives an excellent account of everything the beginner needs to know. The illustrations are clear, the text is concise, the colour photographs are of good quality and the authority of the authors shines throughout. At a relatively modest price, this book is thoroughly recommended.

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Hernia Repair Without Disability by Irving L Lichtenstein. 2nd edition. 252 pages, illustrated. Ishiyaku Euroamerica Inc., St Louis, Tokyo. No price given. ISBN 0 912791 30 6

This book consists of a comprehensive review of the natural history and common techniques for dealing with the common abdominal hernias. It reflects the personal experience of the author extending over many years of hernia repair. The surgical trainee should read it critically since, although it contains some excellent and original ideas, for example the plug repair of femoral and recurrent inguinal hernias, it also contains details of the Gallie repair for incisional hernias which would probably not find popular support among many surgeons in the United Kingdom.

I particularly liked the section on local anaesthetic repair of inguinal hernias and the techniques of local anaesthetic infiltration.

The illustrations are well drawn and clear, and although I would not personally purchase this book it would be a useful book for the surgical trainee to review prior to doing his Fellowship.

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